

## **II. REMARKS**

Claim 24 has been cancelled without prejudice, and claims 1, 7, 20 and 25 have been amended. Specifically, independent claims 1 and 20 have been amended to incorporate subject matter from previous claim 24, and to recite “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as supported by ¶ [0076] of Applicants’ specification as originally filed.

Claim 7, which depends upon claim 6, has been amended to recite “removing non-exposed sections by development with aqueous alkali solution having a pH in the range of 9 to 11” as supported by ¶ [0076] of Applicants’ specification as originally filed. Claim 25, which depends upon claim 6, has been amended to recite

“removing non-exposed sections by developing with an aqueous alkali solution having a pH in the range of 9 to 11, wherein the aqueous alkali solution is selected from the group consisting of 0.1 to 5.0 wt% of sodium carbonate dilute solution, 0.1 to 5.0 % wt% of potassium carbonate dilute solution, and 0.1 to 5.0 % wt% of sodium hydroxide dilute solution,”

as supported by ¶ [0076] of Applicants’ specification as originally filed.

The present amendment adds no new matter to the above-captioned application.

### **A. The Invention**

The present invention pertains broadly to a photosensitive resin composition, such as may be used to manufacture a photosensitive element, and/or may be used to manufacture a printed circuit board. In accordance with an embodiment of the present invention, a photosensitive resin composition including the features recited by independent claim 1 is provided. More specifically, the invention according to independent claim 1 relates to photosensitive resin composition comprising: (A) a binder polymer having an acid value of 45-200; (B) a photopolymerizing compound with an ethylenic unsaturated bond; (C) a photopolymerization initiator; and (D) a compound represented by the following general

formulas (1a), (1b), (1c), or (2). Component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component, component (B) contains a bisphenol A-type (meth)acrylate compound, and component (C) contains a 2,4,5-triarylimidazole dimer” according to the embodiment of the invention recited by claim 1.

In accordance with another embodiment of the present invention, a photosensitive resin composition including the features recited by independent claim 20 is provided. Various other embodiments, in accordance with the present invention, are recited by the dependent claims.

An advantage provided by the various embodiments of the present invention is that a photosensitive resin composition is provided that unexpectedly exhibits improved adhesion and photosensitivity characteristics.

Conventionally, a photosensitive resin composition may obtain improved photosensitivity by means of a photosensitive initiator, such as 2,4,5-triphenylimidazole dimer; however, it cannot obtain desirable properties pertaining to a less contaminating plating solution, resolution and adhesion properties (See, e.g., ¶ [0007] of Applicants’ specification). Generally, as would be known by a person of ordinary skill in the art, raising the photosensitivity can harden the unexposed parts of the photosensitive resin composition layer and, as a result, tends to make resolution low. Furthermore, strengthening adhesion to the substrate tends to also make resolution low. Thus, as would be known by a person of ordinary skill in the art, adhesion and resolution characteristics are in a trade-off relationship (i.e., as one improves, the other deteriorates). Consequently, as would be known by a person of ordinary skill in the art, it has been difficult to simultaneously improve and/or balance photosensitivity, resolution, and adhesion characteristics. Furthermore, the addition of photopolymerization initiator, which has poor solubility to organic solvents such as 2,4,5-

triarylimidazole dimer, in relatively large amounts can cause a problem with respect to sludge generated in the developer (See, e.g., ¶ [0007] of Applicants' specification).

By having components (A) to (D), a photosensitive resin composition, in accordance with the presently claimed invention, maintains high photosensitivity properties while maintaining sufficiently high resolution and adhesion properties and while suppressing contamination of the plating solution and the generation of sludge in the developing process. Sludge in the developing process refers to oily sludge that is generated without dispersing or dissolving in the developing process. Such generated sludge adheres on the substrate and may cause a short circuit and disconnection in the circuit pattern after etching or plating treatment. Furthermore, the sludge can adhere to the developer tank and contaminate it. Therefore, it is desirable to sufficiently suppress the generation of sludge as is achieved by the present invention.

**B. The Rejections**

Claims 1, 3-20 and 23-26 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Ohta et al. (U.S. 5,476,690, hereafter the "Ohta Patent") in view of Grubb et al. (U.S. 3,647,467, hereafter, the "Grubb Patent"). Claims 1, 3-6, 10-20 and 23-26 also stand rejected under 35 U.S.C. § 103(a) as unpatentable over Amanokura et al. (U.S. 6,060,215, hereafter the "Amanokura Patent") in view of the Grubb Patent and the Ohta Patent.

In view of the present amendment, Applicants respectfully traverse the present rejections and request reconsideration and allowance of the claims for the following reasons.

**C. Applicants' Arguments**

A prima facie case of obviousness requires a showing that the scope and content of the prior art teaches each and every element of the claimed invention, and that the prior art

provides some teaching, suggestion or motivation, or other legitimate reason, for combining the references in the manner claimed. KSR International Co. v. Teleflex Inc., 127 S.Ct. 1727, 1739-41 (2007); In re Oetiker, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992). Furthermore, a proper rejection under Section 103 requires showing that when a person of ordinary skill in the art would have had a legitimate reason to attempt to make the composition or device, or to carry out the claimed process, that the person of ordinary skill in the art would also have had a reasonable expectation of success in doing so. PharmaStem Therapeutics, Inc. v. ViaCell, Inc., 491 F.3d 1342, 1360 (Fed. Cir. 2007).

In this case, the Examiner has failed to establish a prima facie case of obviousness against independent claims 1 and 20 because (i) the combination of the Ohta Patent, the Amanokura Patent and the Grubb Patent does not teach, or suggest, “wherein component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A),” and (ii) “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as recited by claims 1 and 20 of the present application, (iii) the Examiner has failed to establish a legitimate reason to justify the combination of the Ohta Patent with the Grubb Patent, and (iv) because the Examiner has failed to establish that a person of ordinary skill in the art would have had a reasonable expectation of success of arriving at Applicants’ claimed invention if the combination of Ohta, Amanokura and Grubb was made.

## **ii. The Ohta Patent**

The Ohta Patent discloses a “process for preparing printed circuit board” that includes the steps of: (1) forming, on the surface of an insulating substrate on a necessitate portion of which electrolessly plated copper is to be precipitated, a layer of a light-sensitive resin composition comprising (a) 40 to 80 parts by weight of a vinyl-polymerized high molecular

weight binder having an acid value of 10 to 46 mgKOH/g, (b) 20 to 60 parts by weight of a compound having at least two polymerizable unsaturated double bonds in a molecule, with the total amount of Components (a) and (b) being 100 parts by weight, and (c) a photopolymerization initiator generating free radicals by irradiation of active light in an amount of 0.1 to 10 parts by weight based on 100 parts by weight of Components (a) and (b); (2) forming a negative pattern of the light-sensitive resin composition on the surface of the substrate by irradiating active light imagewise and developing with a semi-aqueous developing solution; and (3) forming a circuit pattern by electroless copper plating by using the negative pattern of the light-sensitive resin composition on the surface of the substrate as a plating resist (See Abstract of the Ohta Patent). The Ohta Patent discloses that the binder polymer having an acid value of 10 to 46 mgKOH/g is a high molecular weight binder, that the compound having at least two polymerizable unsaturated double bonds in a molecule may be bisphenol A, and that the photopolymerization initiator may be 2,4,5-triarylimidazole dimer (Ohta Patent, col. 4, lines 5-10; col. 5, lines 55-59; and col. 6, lines 13-33).

As examples of vinyl monomer used for vinyl-polymerized type high molecular weight binder, the Ohta Patent discloses (meth)acrylic acid alkyl esters such as acrylic acid, methacrylic acid, and methyl methacrylate, styrene, and styrene derivatives such as  $\alpha$ -methylstyrene (Ohta Patent, col. 4, lines 5-13). Although the Ohta Patent discloses that styrene or a styrene derivative can be used, the Ohta Patent does not teach, or suggest, (i) “component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)” as recited by independent claims 1 and 20. According to Applicants’ disclosure (See Applicants’ original specification, ¶ [0027]), however, photosensitivity and resolution improve together with adhesion and release properties when the content of the styrene or the styrene derivative is in the range of 0.1 to 30 wt%.

In addition, Synthetic Examples 1-5 of the Ohta Patent do not employ a binder polymer that contains styrene or a styrene derivative as claimed. Instead, in Synthetic Examples 1-5, the Ohta Patent discloses a high molecular weight binder that uses methacryl acid, methyl methacrylate and butyl methacrylate as copolymerizing components (Ohta Patent, col. 8, line 65, to col. 10, line 46). Moreover, the Ohta Patent discloses a developing solution that is a “semi-aqueous developing solution,” which contains an alkaline substance and at least one organic solvent (Ohta Patent, col. 7, lines 27-30). Hence, as would be instantly appreciated by a person of ordinary skill in the art, the Ohta Patent does not teach, or suggest, (ii) “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as recited by claims 1 and 20.

As admitted by the Examiner (Office Action, dated December 11, 2008, at 3, lines 5-6; Office Action, dated June 10, 2008, at 4, lines 3-4), the Ohta Patent does not teach, or even suggest, component (D) recited by independent claims 1 and 20, namely, “a compound represented by the following general formula (1a), (1b), (1c), or (2)” as recited by independent claim 1, and “one or more compounds selected from the group...” recited by independent claim 20. However, the above deficiencies are not the only ones in the disclosure of the Ohta Patent.

The Ohta Patent also does not teach, or suggest, adjusting the acid value of the binder polymer to “45-200 mg KOH/g” as recited by claims 1 and 20. Although the Ohta Patent discloses Comparative Synthetic Examples 1 and 2, wherein the binder polymers have acid values of 52 mgKOH/g and 78.2 mgKOH/g, respectively (Ohta Patent, col. 11, lines 1-35), the Ohta Patent also discloses in the Examples at col. 8, line 59, to col. 10, line 46, binder polymers having acid values ranging from 19.6 mgKOH/g to 39.1 mgKOH/g. The Ohta Patent also explicitly states that

the copolymerization rate of the vinyl monomer having an acidic polar

group such as acrylic acid, methacrylic acid and p-vinylbenzoic acid is limited to such a rate that the acid value of the vinyl-polymerized type high molecular weight binder (a) obtained by copolymerization is in the range of 10 to 46 mgKOH/g. If the acid value of the vinyl-polymerized type high molecular weight binder (a) is less than 10 mgKOH/g, developability with a semi-aqueous developing solution is lowered, while if it exceeds 46 mgKOH/g, a gap is generated between a resist and plated copper to lower resistance to electroless copper plating property. In order to obtain better developability and highly reliable resistance to electroless copper plating property, the acid value of the vinyl-polymerized type high molecular weight binder (a) is preferably in the range of 20 to 40 mgKOH/g.

(Ohta Patent, col. 5, lines 8-22, emphasis added).

Thus, the Ohta Patent explicitly teaches away from acid values exceeding 46 mgKOH/g due to the fact that such higher acid values will result in an undesirable gap between the resist and the plated copper so as to lower resistance to the electroless copper plating property. The Ohta Patent pertains to a process for preparing a printed circuit board wherein excellent resistance to electroless copper plating is achieved and contamination of the plating solution is diminished by keeping the acid value of the binder polymer in the range of 10 to 46 mgKOH/g (Ohta Patent, col. 1, line 66, to col. 2, line 13; and col. 5, lines 8-22). Therefore, the subject matter disclosed by Ohta pertains to a completely different technical innovation than that of the present invention, and even teaches away from the limitation wherein “the acid value of component (A) is 45-200 mg KOH/g” as recited by claims 1 and 20 of the present invention.

Furthermore, the subject matter disclosed by the Ohta Patent pertains to development of a light-sensitive resin composition with subaqueatic developer and aims to improve electroless copper plating resistance, and to improve the property of decreasing contamination of a plating solution, by adjusting the acid value of the binder polymer to be in the range of 10 to 46 mgKOH/g. Thus, the Ohta Patent is directed to the improvement of soldering heat resistance and thermal shock resistance, and does not pertain at all to improving properties relating to photosensitivity, resolution, adhesion, minimizing plating

bath contamination and minimizing sludge generation, which are objects of the present invention. The presently claimed invention suppresses contamination of a plating solution and the generation of sludge, and further improves photosensitivity, resolution and adhesion by employing the combination of components (A) to (D) as claimed. The Ohta Patent does not teach, or suggest, that its light-sensitive resin composition can suppress sludge generation, achieve higher resolution, higher photosensitivity, and stronger adhesion, as does the present invention.

**ii. The Amanokura Patent**

The Amanokura Patent discloses a “photosensitive resin composition and application of its photosensitivity,” wherein the photosensitive resin composition comprises: (A) a resin having an amide bond, an oxyalkylene group and a carboxyl group, (B) a photopolymerizable compound having an ethylenically unsaturated group, and (C) a photopolymerization initiator that has alkali developability, good sensitivity and photocurability, an efficient pattern formability by photolithography, a good application workability to a film and is capable of producing cured products having good folding endurance, solder reflow heat resistance, solvent resistance, bondability and nonflammability and is suitable for producing a photosensitive element, a photosensitive laminate and a flexible printed circuit board (See Abstract of the Amanokura Patent). More specifically, the Amanokura Patent discloses, in Synthesis Examples 4-7, a resin having an acid value of 36-77 mgKOH/g (Amanokura Patent, col. 20, line 41, to col. 22, line 52). The Amanokura Patent also discloses utilization of a bisphenol-A-type (meth)acrylate compound at col. 14, lines 14-27, and utilization of 2,4,5-triarylimindazole dimer at col. 14, line 66, to col. 15, line 11.

The Amanokura Patent further discloses that its photosensitive resin composition has aqueous alkali solution developability at a pH of 9-11 (Amanokura Patent, col. 19, lines 1-



15). However, the Amanokura Patent also discloses that, with respect to prior art photosensitive resin compositions, “almost all developing solutions applicable to the foregoing resin materials are organic solvents of an organic solvent and an aqueous alkali solution” (Amanokura Patent, col. 2, lines 12-16). In other words, while the Amanokura Patent discloses that its particular photosensitive resin composition is developable in an aqueous solution in the pH range of 9 to 11, the Amanokura Patent discloses that “almost all” photosensitive resin compositions are only developable in an organic solvent or in a semi-organic solvent (i.e., an organic solvent mixed with an aqueous alkali solution), which is disadvantageous in terms of cost and environmental sanitation (Amanokura Patent, col. 2, lines 10-16).

As would be instantly understood by a person of ordinary skill in the art, various characteristics of a photosensitive resin composition, such as developability, change drastically when the binder polymers are substantially different (i.e., when the binder polymers belong to different chemical families). The binder polymer disclosed by Amanokura is a “resin having an amide bond, an oxyalkylene group and a carboxyl group” (See Abstract of the Amanokura Patent). Therefore, **a person of ordinary skill in the art would not expect photosensitive resin compositions other than those employing a “resin having an amide bond, an oxyalkylene group and a carboxyl group” as binder polymer to exhibit developability in an aqueous alkali solution in the pH range of 9 to 11 based on the entire disclosure of the Amanokura Patent.** See, e.g., In re Gordon, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984)(Federal Circuit holding that the USPTO must give a fair reading to what a reference teaches as a whole).

As admitted by the Examiner (Office Action, dated December 11, 2008, at 7, lines 12-15), the Amanokura Patent does not teach, or suggest, the binder polymer claimed, namely, (ii) “component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic

acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component” as recited by independent claims 1 and 20. Consequently, the Amanokura Patent cannot teach, or suggest, (ii) “component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)” as recited by claims 1 and 20.

However, the Amanokura Patent has additional deficiencies. As admitted by the Examiner (Office Action, dated December 1, 2008, at 6, lines 4-5; Office Action, dated June 10, 2008, at 7, lines 6-7), the Amanokura Patent does not teach, or even suggest, (iii) Component (D) recited by independent claims 1 and 20, namely, “a compound represented by the following general formula (1a), (1b), (1c), or (2)” as recited by independent claim 1, and “one or more compounds selected from the group...” recited by independent claim 20. The Amanokura Patent also does not teach, or suggest, adjusting the acid value of the binder polymer to “45-200 mg KOH/g” as recited by claims 1 and 20.

As would be appreciated by a person of ordinary skill in the art, the photosensitive resin composition disclosed by the Amanokura Patent is directed to the improvement of photosensitivity, resolution, solder reflow heat resistance, folding endurance and noninflammability. However, the Amanokura Patent is silent with respect to improving the properties of adhesion, plating bath contamination, and sludge generation, which are properties improved by the present invention. Furthermore, while the Amanokura Patent may address the properties of photosensitivity and resolution, it employs a binder polymer that is substantially different from that of the present invention, and the Amanokura Patent does not teach, or suggest, “Component (D)” recited by claims 1 and 20 of the present application. Thus, any improvement in photosensitivity and/or resolution achieved by the photosensitive resin composition disclosed by the Amanokura Patent is for a totally different reason (and chemical mechanism) than that of the invention of the present application.

### **iii. The Grubb Patent**

The Grubb Patent discloses “hexaarylbiimidazole-heterocyclic compound compositions,” which are photoactivatable compositions comprising a hexaarylbiimidazole and a heterocyclic compound of the formula  $\text{Ar}^1\text{—G—Ar}^2$  where  $\text{Ar}^1$  is aryl of six to 12 nuclear carbons,  $\text{Ar}^2$  is  $\text{Ar}^1$  or arylene—G— $\text{Ar}^1$  and G is a divalent furan, oxazole or oxadiazole ring, and optionally, a leuco dye and/or a polymerizable monomer or inert components such as binders and solvents, wherein the compositions are photoactivated in the near ultraviolet or visible light wavelengths (See Abstract of the Grubb Patent). More specifically, the Grubb Patent discloses employing polystyrene as a binder polymer, and photopolymerizing compound with an ethylenic unsaturated bond that employs a photopolymerization initiator such as 2,4,5-triarylimidazolyl dimer, a hexaryl biimidazole, and heterocyclic compounds such as 2,5-diphenylfuran (Grubb Patent, col. 3, lines 32-33 and lines 66-69, and col. 10, line 58, and claim 1).

In Example 11, col. 14, lines 34-53, of the Grubb Patent, poly(methyl methacrylate/methacrylic acid) 90/10 is employed as binder polymer in Solution B. A person of ordinary skill in the art would know that the calculated acid value for this binder polymer is 65 mg KOH/g. However, the Grubb Patent does not specifically disclose adjusting the acid value of the binder polymer to accord with the range of 45-200 mg KOH/g as recited by independent claims 1 and 20. None of the other specific examples disclosed by the Grubb Patent include a binder polymer having an acid value in the range of 45-200 mg KOH/g.

The Grubb Patent, however, does not teach, or suggest, (i) “a photopolymerizing compound with an ethylenic unsaturated bond...[that] contains a bisphenol A-type (meth)acrylate compound” as recited by independent claims 1 and 20. The Grubb Patent also does not teach, or suggest, (ii) “component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a

copolymerizing component” as recited by independent claims 1 and 20. Thus, the Grubb Patent also does not teach, or suggest, (iii) “component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)” as recited by independent claims 1 and 20.

The above deficiencies are not the only deficiencies in the disclosure of the Grubb Patent. The Grubb Patent also does not teach, or suggest, (iv) “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as recited by claims 1 and 20.

In sum, the subject matter disclosed by the Grubb Patent relates to a photopolymerization composition for planographic printing plates that has certain optical properties, absorbance and imaging speed properties that are enhanced by combining hexaaryl biimidazole with a compound such as 2, 5-diphenyl furan. More specifically, the Grubb Patent pertains to improving imaging properties, namely, to improving the changing of color in an exposed portion of a resin composition. With respect to printed circuit board production, the issue is to improve operating efficiency. Thus, the Grubb Patent is non-analogous art because the characteristics of photosensitivity, resolution and adhesion are different in the field of circuit board manufacturing from imaging properties. Correspondence of properties in these two substantially different fields does not necessary exist.

The present invention, on the other hand, suppresses contamination of a plating solution and the generation of sludge, and further improves photosensitivity, resolution and adhesion by employing the combination of components (A) to (D) as claimed. The Grubb Patent does not teach, or suggest, a composition that can suppress contamination of a plating solution, suppress sludge generation, and achieve higher resolution, higher photosensitivity, and stronger adhesion, which are advantages achieved by the present invention.

**iv. Summary of the Disclosures**

The Ohta Patent discloses a process for preparing printed circuit board that includes forming, on the surface of an insulating substrate, a layer of a light-sensitive resin composition comprising (a) 40 to 80 parts by weight of a vinyl-polymerized high molecular weight binder having an acid value of 10 to 46 mgKOH/g, (b) 20 to 60 parts by weight of a compound having at least two polymerizable unsaturated double bonds in a molecule such as bisphenol A, with the total amount of Components (a) and (b) being 100 parts by weight, and (c) a photopolymerization initiator, such as 2,4,5-triarylimidazole dimer, generating free radicals by irradiation of active light in an amount of 0.1 to 10 parts by weight based on 100 parts by weight of Components (a) and (b). However, the Ohta Patent does not teach, or even suggest, (i) Component (D) such as “a compound represented by the following general formula (1a), (1b), (1c), or (2)” as recited by independent claim 1, and “one or more compounds selected from the group...” recited by independent claim 20, and (ii) “component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)” as recited by claims 1 and 20, and (iii) “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as recited by claims 1 and 20.

Furthermore, while the Ohta Patent discloses that the binder has an acid value of 10 to 46 mgKOH/g, the Ohta Patent explicitly teaches away from the binder having an acid value of greater than 46 mgKOH/g and even provides comparative examples having acid values of 52 mgKOH/g and 78.2 mgKOH/g to demonstrate the deleterious effect of employing a binder having an acid value in excess of 46 mgKOH/g. Therefore, the Ohta Patent explicitly teaches away from the limitation “the acid value of component (A) is 45-200 mg KOH/g” as recited by claims 1 and 20 of the present invention.

The Amanokura Patent discloses a photosensitive resin composition that comprises:

(A) a resin having an amide bond, an oxyalkylene group and a carboxyl group, (B) a photopolymerizable compound having an ethylenically unsaturated group, and (C) a photopolymerization initiator. The Amanokura Patent does not teach or suggest Component (D) such as (i) “a compound represented by the following general formula (1a), (1b), (1c), or (2)” as recited by independent claim 1, and “one or more compounds selected from the group...” recited by independent claim 20, and (ii) “component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component” as recited by independent claims 1 and 20, and (iii) “component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)” as recited by claims 1 and 20.

While the Amanokura Patent discloses the desirability of being able to develop a photosensitive resin composition in an aqueous alkali solution, the Amanokura Patent discloses that photosensitive resin compositions in general do not have this developability characteristic. The Amanokura Patent only may enable photosensitive resin compositions developable in an aqueous alkali solution when the photosensitive resin compositions employ a particular binder polymer, namely, a resin having an amide bond, an oxyalkylene group and a carboxyl group. The Amanokura Patent does not enable other photosensitive resin compositions that have the desired aqueous alkali developability characteristics, but employ other kinds of binder polymers (i.e., a binder polymer like “component (A)” of the present invention).

The Grubb Patent discloses hexaarylbiimidazole-heterocyclic compound compositions that are photoactivatable compositions comprising a hexaarylbiimidazole and a heterocyclic compound of the formula  $Ar^1-G-Ar^2$ . The Grubb Patent pertains to non-analogous art because it pertains to photosensitive imaging involving color images, which is a

different form of imaging than that employed to make printed circuit boards and the like. Furthermore, the Grubb Patent does not teach, or suggest, “a photopolymerizing compound with an ethylenic unsaturated bond...[that] contains a bisphenol A-type (meth)acrylate compound” as recited by independent claims 1 and 20.

Neither the Ohta Patent, the Amanokura Patent nor the Grubb Patent teach, or suggest, either alone or in combination, (i) “component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component” and “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as recited by independent claims 1 and 20. The combination of the Ohta Patent, the Amanokura Patent and the Grubb Patent also does not teach, or suggest, (ii) “component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)” as recited by independent claims 1 and 20.

For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against claims 1, 4-8, 11, 13, 15, 16, 18-20, 23, 25 and 26 of the above-captioned application.

**v. No Legitimate Reason to Combine Ohta, Grubb and Amanokura**

A prima facie case of obviousness requires a showing that the prior art provides some teaching, suggestion or motivation, or other legitimate reason, for combining the references in the manner claimed. KSR International Co. v. Teleflex Inc., 127 S.Ct. 1727, 1739-41 (2007). In this case, the Examiner has failed to establish a legitimate reason for combining the references in the manner claimed.

The Federal Circuit has held that a modification of a prior art invention that would

obliterate an essential feature thereof would not be obvious. McGinley v. Franklin Sports Inc., 60 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 2001). In this case, the Ohta Patent explicitly discloses that a binder having an acid value that does not exceed 46 mg KOH/g is an essential feature of its light-sensitive resin composition in order to achieve excellent resistance to electroless copper plating and to diminish contamination of the plating solution (Ohta Patent, col. 1, line 66, to col. 2, line 13; and col. 5, lines 8-22). Therefore, modification of the subject matter disclosed by the Ohta Patent so as to employ a binder having an acid value greater than 46 mg KOH/g is not obvious as a matter of law because to do so would obliterate an essential feature of Ohta's resin composition, thereby diminishing its resistance to electroless copper plating and causing contamination of the plating solution. Thus, the Examiner has no legitimate reason to combine Ohta and Grubb to produce a photosensitive resin composition comprising a "binder polymer" that has an acid value of "45-200 mg KOH/g" as recited by claims 1 and 20.

Furthermore, the Ohta Patent pertains to a process for preparing a printed circuit board that achieves excellent resistance to electroless copper plating and diminishes contamination of the plating solution by keeping the acid value of the binder polymer in the range of 10 to 46 mgKOH/g, (Ohta Patent, col. 1, line 66, to col. 2, line 13; and col. 5, lines 8-22). The Amanokura Patent pertains to a photo-sensitive resin composition that may be used to produce a flexible printed circuit board (Amanokura Patent, col. 1, lines 6-12). On the other hand, the Grubb Patent pertains to hexaarylbiimidazole-heterocyclic compound compositions that achieve efficient absorption of UV radiation and improved imaging speed by combining hexaryl biimidazole and a heterocyclic compound of the formula  $Ar^1-G-Ar^2$  (Grubb Patent, col. 1, lines 5-58). Thus, **the Grubb Patent is non-analogous art** because it pertains to photosensitive resin compositions suitable for use in the field of obtaining color images, and not to photosensitive resin compositions suitable for use in the field of manufacturing



printed circuit boards. Consequently, a person of ordinary skill in the art would have absolutely no legitimate reason to combine the subject matter disclosed by the Grubb Patent with the subject matter disclosed by either the Ohta Patent and/or the Amanokura Patent.

The photosensitive resin composition of the present invention unexpectedly achieves not only the property of a less contaminated plating solution (contrary to the teachings of the Ohta Patent), but it also achieves high photosensitivity, satisfactory minimization of sludge generation during developing, high resolution, and good adhesion characteristics. Therefore, the purpose and effect of the present invention is substantially different from that of Grubb's hexaarylbiimidazole-heterocyclic compound compositions and of Ohta's light-sensitive resin composition.

For all of the above reasons, a person of ordinary skill in the art would have no legitimate reason to combine Grubb's heterocyclic compound of the formula  $\text{Ar}^1\text{—G—Ar}^2$  with the subject matter of the Ohta Patent because neither of these references address the problem addressed by the present invention. For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against claims 1, 4-8, 11, 13, 15, 16, 18-20, 23, 25 and 26 of the above-captioned application.

**vi. No Reasonable Expectation of Success Combining Ohta, Amanokura and Grubb**

A prima facie case of obviousness also requires a showing that, in addition to establishing a person of ordinary skill in the art would have had a legitimate reason to attempt to make the claimed composition or device or to carry out the claimed process, the person of ordinary skill in the art would have had a reasonable expectation of success in making the composition or device, or carrying out the process. PharmaStem Therapeutics, Inc. v. ViaCell, Inc., 491 F.3d 1342, 1360 (Fed. Cir. 2007). In this case, the Examiner has failed to

establish that, assuming *arguendo* there is a legitimate reason for combining the references in the manner claimed (which is an invalid assumption), there would have been a reasonable expectation of success of arriving at Applicants' claimed invention.

As discussed above, the Ohta Patent teaches away from employing a binder having an acid value greater than 46 mg KOH/g due to the deleterious effects that would occur, such as plating solution contamination and diminished resistance to electroless copper plating (Ohta Patent, col. 1, line 66, to col. 2, line 13; and col. 5, lines 8-22). In view of the above facts, a person of ordinary skill in the art would have had no reasonable expectation of success of achieving an acceptable photosensitive resin composition, much less one that has all of Applicants' claimed features including a "binder polymer" having an "acid value" of "45-200 mg KOH/g."

Furthermore, as discussed above, the combination of the Ohta Patent, the Amanokura Patent and the Grubb Patent would still fail to teach, or suggest,

"component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component...wherein component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A),"

as recited by independent claims 1 and 20. Therefore, a person of ordinary skill in the art would not have had a reasonable expectation of success of arriving at the claimed invention by combining the disclosures of the Ohta Patent, the Amanokura Patent, and the Grubb Patent.

In addition, the Amanokura Patent is limited to the disclosure of a photosensitive resin composition, developable in an aqueous alkali solution having a pH of 9 to 11, that includes, as its binder polymer, a resin having an amide bond, an oxyalkylene group and a carboxyl group. The Amanokura Patent discloses that photosensitive resin compositions in general are not developable in an aqueous alkali solution, but must be developed in an organic solution or

a semi-organic solution (i.e., a solution comprising an organic solvent and an aqueous alkali solution), (Amanokura Patent, col. 2, lines 10-17). Therefore, the Amanokura Patent is not enabling for a photosensitive resin composition that is developable in an aqueous alkali solution having a pH of 9 to 11, and which employs a binder polymer that contains “polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component” as claimed. Consequently, even if the combination of the Ohta Patent, the Grubb Patent and the Amanokura Patent was made, a person of ordinary skill in the art would not have had a reasonable expectation of success of obtaining a photosensitive resin composition that includes, as its binder polymer, “component (A)” as claimed (i.e., a binder polymer that is substantially different from the binder polymer disclosed by the Amanokura Patent) and that exhibits the property wherein “the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11” as recited in claims 1 and 20.

For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against claims 1, 4-8, 11, 13, 15, 16, 18-20, 23, 25 and 26 of the above-captioned application.

**vii. Evidence of Superior and Unexpected Results**

Although the Examiner has not established a prima facie case of obviousness against the invention of claims 1 and 20 of the above-captioned application, assuming *arguendo* that such a prima facie case had been made (which is plainly an invalid assumption), Applicants have adduced evidence of substantially superior and unexpected results achieved by the present invention that is sufficient to overcome the alleged prima facie case.

The Federal Circuit has ruled that when an applicant adduces specific data demonstrating substantially improved results, and states that the results are unexpected, then

in the absence of evidence to the contrary, applicant has established unexpected results sufficient to prove the invention is nonobvious. In re Soni, 34 U.S.P.Q.2d 1684, 1687-88 (Fed. Cir. 1995). Furthermore, the invention need only be compared to the closest prior art, In re Johnson, 223 U.S.P.Q. 1260, 1264 (Fed. Cir. 1984), however, it is acceptable to compare the invention to subject matter that is closer to the invention than the closest prior art. Ex parte Humber, 217 U.S.P.Q. 265, 266 (Bd. Pat. App. & Inter. 1981). In this case, specific data pertaining to Examples 1-5 of Table 3 of Applicants' specification demonstrate substantially superior and unexpected results sufficient to overcome the Examiner's alleged prima facie case of obviousness.

Specifically, photosensitive resin compositions of Example Nos. 1 to 5, and Comparative Example Nos. 1 and 2, described on page 28, line 5, to page 30, line 13, of Applicants' specification were used to fabricate photosensitive elements and test samples as described on page 30, line 15, to page 31, line 22, of Applicant's specification as originally filed. These photosensitive elements were tested for properties relating to photosensitivity, resolution, adhesion, plating bath contamination, and generation of sludge volume as described on page 31, line 23, to page 36, line 3, of Applicants' specification as originally filed. As evident from Table 2, on page 30 of Applicants' specification, Comparative Example Nos. 1 and 2 differ substantially from Example Nos. 1 to 5 in that Comparative Example Nos. 1 and 2 do not contain component (D) in the photosensitive resin composition used to make the photosensitive elements. Thus, Comparative Example Nos. 1 and 2 are similar to the subject matter disclosed by the Ohta Patent and the Amanokura Patent, each of which disclose compositions lacking component (D).

Applicants contend that the Ohta Patent and the Amanokura Patent represent the "closest prior art" in this case. Comparative Example Nos. 1 and 2, however, represent subject matter that is closer to the claimed invention than that of the "closest prior art"

because components (A) and (B) used to make Example Nos. 1 to 5 and Comparative Example Nos. 1 and 2 were identical as shown by Table 1 of Applicant's disclosure. Furthermore, component (C) used to make Example Nos. 1 and 5 was substantially similar to that of component (C) used to make Comparative Example Nos. 1 and 2 as shown by Table 2 of Applicants' disclosure. For all of the above reasons, Applicants have acceptably compared the presently claimed invention to subject matter that is closer to the invention than the "closest prior art." Ex parte Humber, 217 U.S.P.Q. 265, 266 (Bd. Pat. App. & Inter. 1981).

Table 3 of Applicant's disclosure tabulates the results of the comparison, and is reproduced below for the Examiner's convenience.

Table 3 of Applicant's Disclosure

	Example 1	Example 2	Example 3	Example 4	Example 5	Comp. Ex. 1	Comp. Ex. 2
Photosensitivity	9	9	9	9	9	8	9
Adhesion ( $\mu\text{m}$ )	35	30	30	35	30	40	45
Resolution ( $\mu\text{m}$ )	40	40	40	40	40	45	45
Plating bath contamination [Alloy ratio]	0.97	0.98	0.97	0.99	0.98	0.97	0.7
Sludge volume (g/L)	0.5	0.7	0.9	0.7	0.5	1.8	1.5

As evident from the data compiled in Table 3, adhesion and resolution characteristics of Example Nos. 1 to 5 (i.e., Adhesion ranging from 30-35  $\mu\text{m}$ , and Resolution of 40  $\mu\text{m}$ ) of the present invention were substantially improved over those of Comparative Example Nos. 1 and 2 (i.e., Adhesion ranging from 40-45  $\mu\text{m}$ , and Resolution of 45  $\mu\text{m}$ ) while photosensitivity characteristics of the present invention were maintained with respect to those of Comparative Example Nos. 1 and 2. This result is surprising in view of ¶¶ [0006]-[0010] of Applicant's disclosure because components that improve photosensitivity, such as a photopolymerization initiator, are expected to diminish adhesion and resolution characteristics. As evident from Table 3 above, this expected trade-off of properties was not observed, or was less pronounced, in Example Nos. 1 to 5 than in the Comparative Examples

because the photosensitive compositions employed by Example Nos. 1 to 5 each included component (D), which Comparative Example Nos. 1 and 2 are lacking.

Furthermore, Table 3 demonstrates that Example Nos. 1 to 5 of the present invention exhibit substantial improvement in avoiding sludge generation over Comparative Example Nos. 1 and 2 (c.f., sludge volume of 0.5 to 0.9 g/L for Example Nos. 1 to 5 to a sludge volume of 1.5 to 1.8 g/L for Comparative Example Nos. 1 and 2). Thus, the present invention exhibits a decrease in sludge generation of about 40% or more over Comparative Example Nos. 1 and 2. This substantial decrease in sludge generation exhibited by the present invention, which includes component (D), is another wholly unexpected result that could not be predicted by the prior art. Also, while Comparative Example No. 2 generated a lower sludge volume than Comparative Example No. 1, it exhibited an especially poor plating bath contamination ratio.

In sum, Applicants have demonstrated that the presently claimed invention, according to claims 1 and 20 of the above-captioned application, unexpectedly exhibits substantially improved adhesion and resolution characteristics, and unexpectedly exhibits substantially decreased sludge generation, over subject matter (i.e., Comparative Example Nos. 1 and 2) that is closer to the presently claimed invention than the subject matter disclosed by the Ohta Patent and the Amanokura Patent. Therefore, Applicants have provided the Examiner with evidence of unexpectedly and substantially superior results sufficient to overcome the Examiner's alleged prima facie case of obviousness.

Applicants' remind the Examiner that "all evidence of nonobviousness must be considered when assessing patentability," which includes comparative data contained in the applicants' specification. In re Soni, 34 U.S.P.Q.2d at 1687. **The Examiner has not offered any explanation regarding why the comparative evidence contained in Table 3 of Applicants' specification is not sufficient to overcome the Examiner's alleged prima**

**facie case of obviousness.** The Examiner's silence on this issue speaks volumes.

For all of the above reasons, the Examiner should withdraw the Section 103 Rejection standing against claims 1, 4-8, 11, 13, 15, 16, 18-20, 23, 25 and 26.

### **III. CONCLUSION**

The Examiner has failed to establish a prima facie case of obviousness against Applicants' claimed invention because neither the Ohta Patent, the Amanokura Patent nor the Grubb Patent, alone or in combination, teaches or suggests (i) "component (A) contains polymerizable monomer with a carboxyl group, (meth)acrylic acid alkyl esters, and styrene or a styrene derivative as a copolymerizing component" and "the photosensitive resin composition is developable in an aqueous alkali solution having a pH in the range of 9 to 11," and (ii) "component (A) contains 0.1 to 30 wt% of the styrene or styrene derivative as a copolymerizing component, with respect to the total amount of component (A)" as recited by independent claims 1 and 20. Furthermore, the Examiner has failed to adduce a legitimate reason to justify combination of the disclosures of the Ohta Patent, the Grubb Patent and the Amanokura Patent because the Grubb Patent is non-analogous art. The Examiner has also failed to demonstrate that a person of ordinary skill in the art would have had a reasonable expectation of success of arriving at the Applicants' claimed invention even if the combination of the Ohta Patent, the Amanokura Patent and the Grubb Patent was made.

In addition, Applicants have adduced evidence of substantially superior and unexpected results provided by the presently claimed invention when compared to subject matter that is closer to Applicants' claimed invention than the subject matter disclosed by the Ohta Patent and the Amanokura Patent (i.e., the closest prior art). Therefore, even assuming the Examiner had established a prima facie case of obviousness (which is an invalid assumption), Applicants' evidence of substantially superior and unexpected results is

sufficient to overcome the alleged prima facie case.

For all of the above reasons, claims 1, 4-8, 11, 13, 15, 16, 18-20, 23, 25 and 26 are in condition for allowance, and a prompt notice of allowance is earnestly solicited.

Questions are welcomed by the below signed attorney for the Applicants.

Respectfully submitted,

GRIFFIN & SZIPL, P.C.

A handwritten signature in black ink, appearing to read 'Joerg-Uwe Szimpl', is written over a horizontal line.

Joerg-Uwe Szimpl  
Registration No. 31,799

Griffin & Szimpl, P.C.  
Suite PH-1  
2300 Ninth Street, South  
Arlington, VA 22204

Telephone: (703) 979-5700  
Facsimile: (703) 979-7429  
Email: GandS@szimpl.com  
Customer No.: 24203